BULLETIN No. 7

ATMOSPHERIC COOLING TOWERS

MITCHELL-TAPPEN COMPANY

SINGER BUILDING

NEW YORK

COOLING TOWERS.

The Mitchell-Tappen Atmospheric Cooling Tower has an unbroken record of satisfied users from the first to the last installation, its high efficiency being the result of much practical experience, improvement where possible, and a wide knowledge on the part of our engineers of the best tower construction in this country and abroad.

The great saving in cooling water effected by it has been demonstrated in the following industries:

REFRIGERATION: In plants dependent upon city water for their ammonia condensers, a reduction of over 90% in water bills has been made. In plants having a limited supply of well water the bills can be eliminated.

STEAM ENGINE POWER: The fuel economy of 20% to 30% effected by condensing over non-condensing engines depends upon a copious supply of condensing water. If this water is purchased, the cost exceeds the saving in fuel. A cooling tower enables any plant having enough water for its boiler feed only to operate on a condensing basis.

GAS AND OIL ENGINE POWER: These engines as power generators have come to stay, but in large installations the cost of cooling water largely offsets the fuel economy. Well water is generally unsatisfactory owing to deposits of scale in the engine jackets. The cooling tower eliminates these objections and provides without increased cost a larger circulation, thus reducing the expansion stresses so destructive in large cylinders.

MISCELLANEOUS USES: Cooling towers solve many problems in heating and cooling such as distilling, evaporative processes, tempering baths, oil cooling, and water cooled rollers.

OPERATION.

Instead of wasting to the sewer the cooling water passes through the tower where the heat taken from the hot body is given to the atmosphere. The cooling water, less from 2% to 3% evaporated, which must be made up, is then returned to the hot body ready for further use and the cycle repeated indefinitely.

TYPE OF TOWER TO BE SELECTED.

The only question really before the enlightened manager today is the type and make of tower best suited to his needs. If space is ample the atmospheric type, when well designed, combines maximum efficiency with maximum economy in cost, running expenses, maintenance, and depreciation.

As an example of the high cost of operating forced draught towers, we cite a large can-ice plant in Baltimore, Md., where the power required to operate the fans per 100 tons refrigeration making 60 tons of can-ice was 10.8 B. H. P. The cost of this power at 3c per K.W. (motor efficiency 80%) is $225.00 per month of 30 days of 24 hours.

SCIENTIFIC DESIGN.

Our engineers have specialized in this subject and designed a tower capable of solving any cooling problem within the limits of a cooling tower. With a given set of climatic conditions, capacity and cooling range, we can furnish a tower properly

proportioned to meet guaranteed specifications. But aside from obtaining the specified temperature reduction, there are other important considerations, viz., running expense, upkeep, and depreciation. If such charges are excessive the saving in the water bill effected by a tower will obviously be offset to a large extent. Our aim has been to produce not only a highly efficient tower, but thoroughly reliable and durable.

COOLING TOWER TROUBLES.

The prudent owner will guard against cooling tower troubles due to poor design, rapid deterioration and insufficient and improper materials, by demanding a tower designed and built by experienced cooling tower specialists.

Owing to their apparent simplicity crude attempts at cooling towers exist which give poor results and decay rapidly. Many such towers are becoming a menace to their surroundings, for example: At a packing house in Detroit a severe wind storm blew down a large slat tower, owing to defective wind bracing, and put the plant out of commission for several months. In Chicago another slat tower collapsed from rusted fastenings, and upon examination the wreck was found to contain an unsuspected load of forty tons of scale and sedimentary deposits which could not have been removed while the tower was in service, as its interior was inaccessible for inspection or repairs.

Such experiences lead some owners and engineers to lay the trouble upon cooling towers in general instead of as is the case with faulty design due to inexperience.

The principal sources of trouble in practically operating cooling towers are as follows:

CORROSION AND DECAY: As all parts of the tower are immersed in spray and warm humid air, corrosion and decay are among the most serious enemies of the apparatus. All steel parts should be of substantial thickness, well covered with protective paints, and so located that they can be thoroughly repainted and inspected without dismantling the tower. Thin galvanized iron or netting, not accessible for painting, are unsuitable, as these materials usually last but a few years, giving out first at sharp bends where the galvanizing is cracked. Where the water is slightly acid, or the air contains sulphur, as in the Pittsburg district, corrosion is much accelerated.

Lumber used in a tower is alternately wet and dry, invariably producing quick decay when unpainted, and the life of towers so constructed is usually from four to eight years. Any lumber that cannot be painted, such as the cooling surfaces, should have great decay-resisting qualities, such as possessed by Louisiana Cypress or Virginia Swamp Cedar. Cheap lumber, creosoted or impregnated with other substances, is objectionable, as the constantly running water washes out the preservatives, and deposits them with injurious consequences on the tubes or plates of the condensers and other apparatus the tower is serving.

Nails and screws should be eliminated because their life is short. If such fastenings are depended upon for structural strength their failure will lead to sudden and disastrous collapse. This has happened both here and abroad. The design should so concentrate the fastening that instead of innumerable small nails, a few galvanized bolts of substantial size will meet the requirements. In the best practice the steel framework should supply the structural strength independent of all lumber filling.

CLOGGING: Owing to the evaporation of a small percentage of the water circulated, incrustation will take place from deposits of salts in solution and suspended matter, besides which there forms in many waters during the summer months, a heavy vegetable growth of moss and algæ.

If the action of the tower depends on small openings (saw teeth, slits or perforations) such openings will become clogged, necessitating frequent vexatious stoppages for cleaning, and consequent labor cost and loss of service when the tower is greatly needed. All openings should be of such size that the tower may be operated for a whole season without cleaning.

ICE will form on all surfaces exposed to spray and may continue to increase in thickness until heavy enough to seriously strain or even rupture a flimsy structure, as has frequently happened with poor designs in the past. All parts of the tower should be strong enough to sustain a considerable ice load. In addition, provision should be made for reducing the exposed water surface in winter so as to keep the minimum temperature within the tower well above the freezing point.

WINDAGE: In poorly designed forced draught and atmospheric towers, entrained water is sometimes carried off in very large quantities, reducing the water saving and possibly causing complaint from the owners of adjoining property.

NOISE: Towers containing thin metallic cooling surfaces or decks form a sounding board, which emits the intensified sleep-destroying noise of a tin roof in a hard rain storm. Some such towers in cities have been declared a public nuisance and been shut down at night by Boards of Health.

IMPERFECT DISTRIBUTION AND SUBDIVISION: The efficiency of a tower as a cooling agent depends largely upon the even distribution and subdivision of the falling water. It is difficult to evenly distribute and subdivide large quantities of water, and still more difficult to maintain these conditions. The clogging effect of sedimentary deposits and vegetable growths is fatal to all distributing and subdividing systems depending on small openings, slots, and triangular notches. Variations in level, caused by shrinking and swelling of timber framework, spoil good distribution; as do also variations in flow, that is, most distributing systems set for full flow, will distribute unevenly at three-quarter capacity, and very poorly at half capacity.

As soon as uniform distribution ceases, dry spots appear in parts of the tower, with correspondingly greatly increased flow at other points. The dry spots are so much tower out of business, while the concentration elsewhere destroys subdivision and prevents the intimate contact which should exist between the air and water; owing to both of these defects, the efficiency of the tower falls off rapidly.

WIND-STORMS: For best results an atmospheric tower should be fully exposed to the prevailing summer winds, and therefore is generally located on roofs or in open spaces, which at the same time expose it to the severe wind-storms of the fall and winter.

The wind bracing and anchorage should follow the best engineering practice to avoid risk of disastrous collapse. Too much is at stake to consider saving in first cost if accomplished by weakening the structure to save material.

THE MITCHELL-TAPPEN ATMOSPHERIC COOLING TOWER.

No cheap, flimsy or makeshift structure will meet the conditions imposed upon an atmospheric cooling tower, and therefore this tower costs more to produce than any other on the market, because

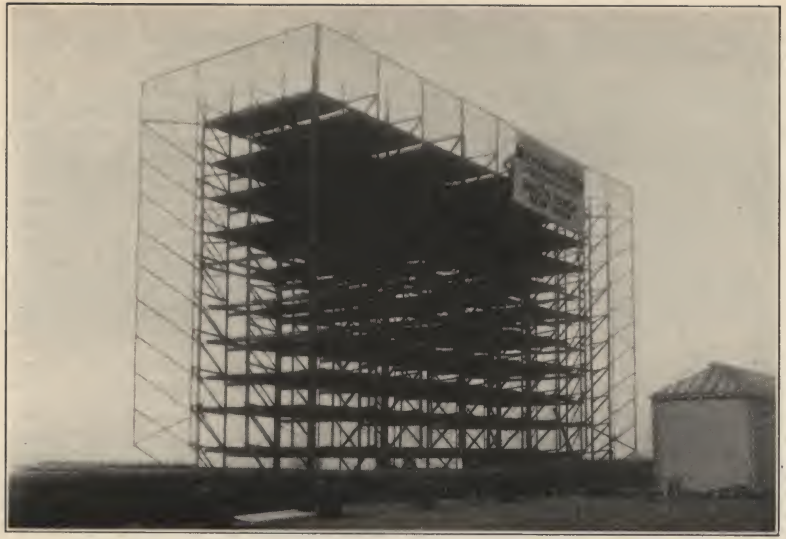
(1) The materials of which it is constructed are the very best that can be procured for the specific purpose which each part plays in the structure.

(2) Generous quantities of these materials are used to cover not only our special design, but also wear and tear and extraordinary strains imposed by heavy ice loads and tornadoes.

(3) Therefore the design and workmanship necessarily involve a larger fabrication cost than is entailed in the structures of cheaper towers.

Our towers consist essentially of a structural steel frame, enclosing and supporting a series of wooden decks or cooling surfaces one above the other. At the top of the frame is the primary distributing system of steel and cast-iron to which is connected the supply-pipe. The exterior of the steel frame is made up of inclined members carrying the louvre system, which keeps the water from blowing out of the tower. Beneath the tower is a steel, wood or concrete collecting basin from which the discharge is taken.

THE FRAME consists of a series of vertical latticed angle iron girders joined by longitudinal and transverse angle and I-beam struts, the bracing being completed by



TYPICAL STEEL FRAME

transverse and longitudinal systems of tie rods with upset ends, and right and left drop-forged clevises.

These members are designed to take all live and dead load stresses with a safety factor of four, and the wind bracing and anchorage is proportioned to resist a horizontal pressure of 30 lbs. pr. sq. ft. (about equivalent to a 97 mile wind) on all exposed areas and 12 lbs. pr. sq. ft. acting vertically for lift of louvres on the windward side. The bulk of the frame is shipped riveted, leaving a few field bolts to complete the erection. All parts receive a thorough coat of best metal paint before leaving our works, and a second coat after erection, their arrangement being such that all steel work can be easily reached without dismantling any part of the tower. If scraped and painted at reasonable intervals the steel work will last indefinitely. The main supporting members are from $\frac{1}{4}$ in. to $\frac{5}{16}$ in. thick, and the members supporting the louvre system are not less than $\frac{3}{16}$ in. thick, all having a tensile strength of 60,000 lbs. per square inch. The frame is absolutely rigid and will keep the distributing system level indefinitely.

The general appearance of the frame is shown by the photograph on page 9.

THE COOLING SURFACES OR DECKS are of Swamp Cedar, cut in the Dismal Swamp, Va. This lumber holds the record for resisting decay when exposed to wet and dry conditions, acid fumes, etc. Gutters and leaders made of it have been in service forty years in the vicinity of Norfolk, Va., and are still in good condition, and tanks are still good after twenty years' use. We believe that it is the best water-wood the country produces, and back our opinion with a ten year guarantee of service

in our towers. This lumber is milled to our patented section and the decks made up as shown at Fig. 1, page 12. Separators are inserted in the grooves at intervals between the bars, securing both their spacing and alignment, so that a deck formed in this way is solid and free from warping and distortion. The water falling upon these decks is first broken into spray, then flows down the sides of the bars and drips from the two bottom grooves spaced 1½ in. apart as illustrated, each bar dividing the water it receives into two rows of parallel drops, thus producing a most minute subdivision of the water in transit. The upper or distributing deck, shown at Fig. 2, is laid in the same manner, but the upper surface of the bars is in gutter form to receive the water from the distributers and spread it evenly over the entire area of the tower.

The whole deck system is held firmly together by ⅜ in. and ½ in. galvanized bolts and lag screws, all nails and small screws having been eliminated because of their short life.

Our wooden deck system renders the tower practically noiseless.

THE PRIMARY DISTRIBUTERS are of our open gutter type, page 12, of either cast iron or wood, illustrated by Fig. 2. The supply enters the main launder and flows through nozzles having a 2 in. square outlet into open cast iron gutters, which are provided with inclined bottoms producing a gradually decreasing section. The effect of this is to cause the water to rise in level and overflow the edges of the gutter in a uniform film throughout its entire length, regardless of variations in flow. The water then collects at the drip points forming the lower edges of the distributer and enters the gutters of the distributing drip bars which form the upper deck. The distributers are so spaced as to insure a uniform spread over the entire distributing deck. All notches, slots and perforated pipes are avoided, and it will be obvious that clogging cannot occur.

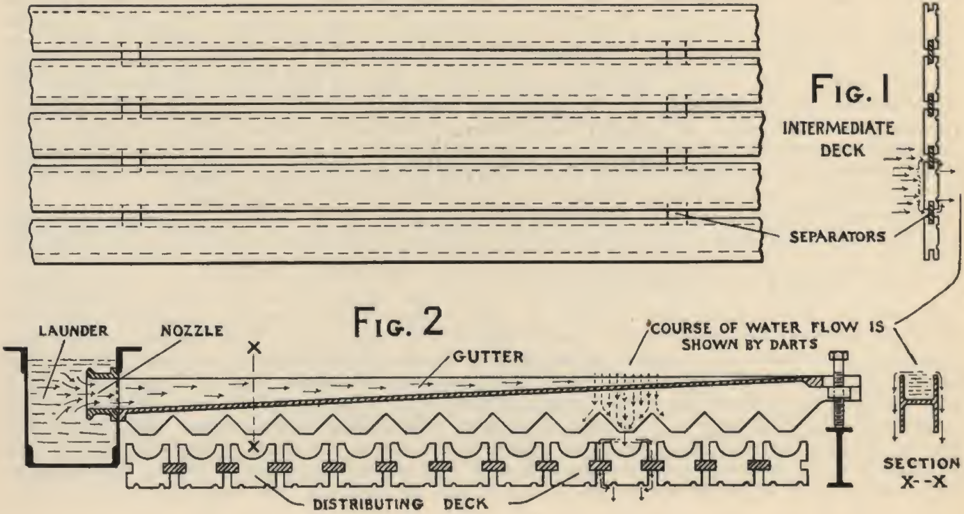


FIG. 1
INTERMEDIATE DECK
SEPARATORS
FIG. 2
LAUNDER
NOZZLE
X
GUTTER
COURSE OF WATER FLOW IS SHOWN BY DARTS
X
DISTRIBUTING DECK
SECTION X--X

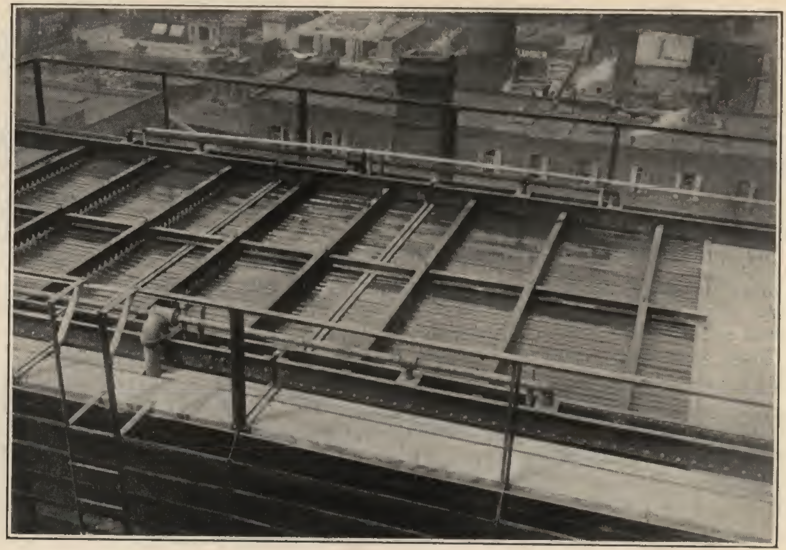
The distributers are planed on the upper edges to exact line and provided with adjusting screws to bring them to absolute level. The photograph on page 14 illustrates the distributing system on one of our large towers.

THE SECONDARY DISTRIBUTERS consist of nozzles attached to a horizontal length of pipe branching from the main supply near the base of the tower, and are for winter use when a less perfect system of distribution and a smaller portion of the cooling space of the tower will give the desired temperature reduction. Two important advantages are thus gained: first, the water is not cooled below the freezing point, and consequently the tower is iced very lightly if at all, and then only near the base; second, the pumping head is reduced, thereby saving power.

Attention is called to not only the advantage of our distributing systems, but also to the fact that we furnish them complete with the tower ready for pipe connections. It has been the custom with some makers to require the purchaser, at his own expense, to have local pipe-fitters furnish and set the distributing system.

THE LOUVRES, preventing the loss of water from windage, consist of either galvanized corrugated steel, neither bent nor crimped, or tongue and groove boards. They are bolted to the steel frame and inclined at an angle of 45°, being so spaced as to prevent loss of water from wind with minimum resistance to free air circulation. The louvres are strong and substantial and well able to stand under a severe ice load.

THE GALLERY is a two-foot walkway around the entire top of the tower protected by a railing three feet high, thus giving safe access to every part of the distributing



TYPICAL DISTRIBUTING SYSTEM

system for regulation and inspection. The gallery is reached by a steel ladder outside the louvres. In freezing weather the top of a cooling tower often becomes coated with a thin film of ice, rendering footing insecure, and we believe the safety to employees and immunity from accident provided for in our towers is well worth the extra cost.

ACCESSIBILITY is one of their strong features, every part being open for inspection, cleaning, painting and repairs, without dismantling or removing any of the structure or its appurtenances.

THE THERMAL EFFICIENCY of our towers as shown by the tests has not been equalled by any records heretofore published of which we are aware.

GUARANTEES.

COOLING TOWER GUARANTEES have in the past involved much uncertainty. Arbitrary assumptions of co-existing temperature and humidity have been made as a basis for guaranteed temperature reductions and capacity. As the assumed temperature and humidity rarely occur at the same time, it is practically impossible to determine whether or not the tower is meeting its guarantee.

OUR GUARANTEE is based on the average meteorological conditions for July, which the U. S. Weather Reports show to be the severest month in the year. These records go back thirty years and cover most of the principal cities of the country, and from them an extremely accurate knowledge of local climatic conditions can be obtained. Our guarantee, therefore, based on these averages, has two very important advantages; first, the purchaser knows exactly what to expect from a tower in his

locality; second, he will have no trouble in ascertaining at any time if his tower is meeting the guarantee.

The lowest temperature attainable by cooling in free contact with the atmosphere is shown by the wet-bulb thermometer (such as is used by the U. S. Weather Bureau in determining relative humidity), which thus becomes the measure of efficiency for any cooling tower, regardless of specific construction. A perfect tower having 100% efficiency would reduce the temperature of the entering water to that of the wet-bulb, and the number of degrees thus abstracted would be the ideal range. The degrees abstracted in practice are the actual range; and the actual range divided by the ideal range gives the efficiency of the tower, or percentage of the ideal range realized.

The average temperature reduction effected in summer weather by towers now operating in this country and abroad, derived from a large number of tests, is given by the formula:

$$T_1 = \frac{t + 2\,t_1 + T}{4}$$

t = temperature of dry bulb, or air.
t_1 = " " wet "
T = " " entering water.
T_1 = " " leaving "

We guarantee the Mitchell-Tappen Atmospheric Towers to do better than the results indicated by this formula, which they have exceeded by from 10% to 50%, depending on cooling range and atmospheric conditions.

In addition to capacity, overload, water loss and temperature guarantees, we will guarantee the life of our tower and its continuous operation without clogging during the working season.

TESTS OF MITCHELL-TAPPEN ATMOSPHERIC COOLING TOWERS.

Tables I, II, III, pages 21, 22, 23, were photographed from our standard test blank, The results given in columns 1 to 15 we think sufficiently plain with the possible exception of columns 7, 10 and 11. The results shown in these three columns are obtained by applying the formula on page 16 to the temperature conditions of the tower under test, and hence afford a comparison of the actual results, with the average results now being obtained by towers in general under similar circumstances. These tests are largely the work of our customers' engineers.

Table I, page 21, gives tests of low temperature towers suitable for straight refrigeration, Attention is called to tests 2, 3, and 5, made in extremely hot weather. In test 4 there was no wind, the cooling being effected entirely by natural draft.

Table II, page 22, shows tests of high temperature towers capable of abstracting from 25° to 50°, and suitable for gas-engine and steam-condenser work. Attention is called to test 3, without wind, when 31° were removed and the final temperature approached to within 6° of the wet-bulb.

Table III, page 23, illustrates the gain that can be made by applying the Mitchell-Tappen system to old towers of low efficiency. Tests 1, 2, 3 and 4 are of an old pan tower. Tests 5, 6, 7 and 8 are of the same tower remodeled to the Mitchell-Tappen system.

Table IV, page 25, shows the only published series of systematic tests on windage and evaporation of which we are aware. They were made by the owners' engineering department over a period long enough to give a reliable average.

The practical test of a tower, however, is the work accomplished over an extended period of hot weather, and we therefore submit on page 24, the complete August log of low and high temperature towers operating on the same site in New York City, in which the monthly average temperature of discharge was respectively 67.6° and 74.6°. The temperatures were taken by the owner's engineers and are plotted to show at a glance the relation of the results to the severest atmospheric conditions each day of the month, obtained by making the observations at 2 P. M., the hottest part of the day.

CAPACITY AND SPACE OCCUPIED.

Owing to climatic differences at the site, variations in cooling range and differences in the required approach to the wet-bulb all being factors in determining the proper area of cooling surface, it is impossible to list cooling towers by capacity. The best that can be done is to give the overall plan area usually occupied for given capacities in gallons per minute.

APPROXIMATE PLAN AREA OCCUPIED.

Gals.	25	50	75	100	200	300	400	500	600
Area	10′—9″ × 7′—9″	10′—9″ × 10′—9″	10′—9″ × 13′—9″	10′—9″ × 16′—9″	19′—0″ × 19′—0″	19′—0″ × 24′—9″	19′—0″ × 30′—6″	19′—0″ × 36′—3″	19′—0″ × 42′—0″

(Information on larger sizes by special correspondence.)

Every installation must be treated as a special problem, and in order to make an intelligent recommendation and estimate we need the following information:

GENERAL:

1. Location of plant — City and State.
2. Location of tower — Roof or ground.
3. Exposure — Is place selected for tower well exposed to prevailing summer winds?
4. Fire regulations — Is exterior woodwork prohibited in your town by Building Dept.?
5. Water Supply — State what well or river water you have available in gals. pr. min. and its summer temperature. Describe quality of water, hard or soft, muddy or clear. Give summer temperature of city water if same must be used.
6. When do you want delivery?

FOR REFRIGERATION:

7. Rated capacity of compression machines in tons of refrigeration?
8. Rated capacity of absorption machines in tons of refrigeration?
9. Do you make distilled water ice? If so, how much in tons per day?

10. Type of ammonia condenser (double or single tube) and diameter and total length of pipe?
11. Type of steam condenser (flat side, exposed tube or submerged) and diameter and total length of pipe?
12. Send sketch giving the levels and positions of top of ammonia condenser, top of steam condenser, and base of cooling tower, all measured from the ground line.

FOR STEAM ENGINE POWER:

13. Size, type, horsepower and maker of engine?
14. Weight of steam pr. hr. to be condensed?
15. Vacuum in mercury inches required, at 30 in. barometer?
16. Type of condenser (surface, jet or barometric) maker, and whether or not fitted with dry vacuum pumps?

FOR GAS AND OIL ENGINE POWER:

17. Size, type, rated horsepower, and maker of engine?
18. If piston cooled, what water pressure in lbs. and quantity in gals. pr. min.?
19. If producer jacket water is to be cooled, quantity required and temperature on entering and leaving?

FOR MISCELLANEOUS USES:

20. Complete description of the proposition.
21. Quantity of water required in gals. pr. min. with entering and leaving temperatures?

Table I

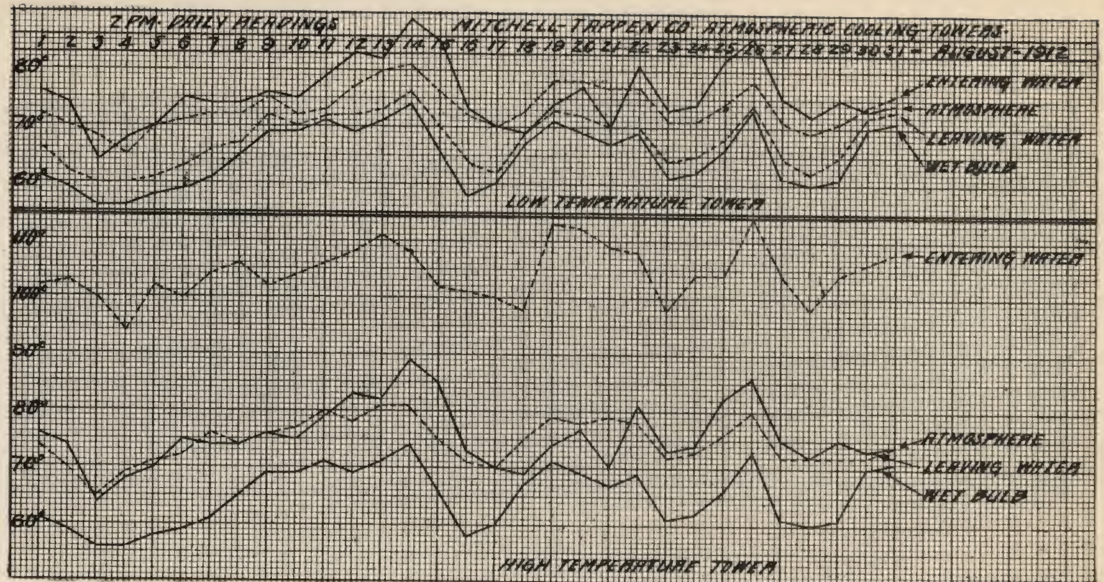
No. Test	Atmospheric Conditions						Cooling-Tower			Cooling Ranges			Efficiencies			Relation of final temp. to wet and dry bulbs	
	Date and Hour		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Dry Bulb t	Wet Bulb t_1	Relative Humidity	Wind Miles per hr. & direction	Initial Temp. T	Final Temp. T_1	Average Final Temp. T_a (note)	Perfect Range $T-t_1$	Actual Range $T-T_1$	Average Range $T-T_a$	Average Efficiency $\frac{T-T_a}{T-t_1}$	Actual Efficiency $\frac{T-T_1}{T-t_1}$	Above or below average ±	Above W. Bulb	Above or below D. Bulb ±
1	8/16/12	11 AM	74°	61°	47%	3-NW	73°	65°	67°	12°	8.0°	6°	50%	66%	+16%	4°	-9°
2	8/14/12	2 PM	89°	74°	48%	Moderate	81°	76°	79.5°	7°	5°	1.5°	21%	71%	+50%	2°	-13°
3	8/14/12	3 PM	93.5°	77°	47%	5-SW	83°	77.5°	82.6°	6°	5.5°	0.4°	6.6%	92%	+85.4%	0.5°	-16°
4	8/17/12	"	70°	60°	55%	0	70°	62°	65°	10°	8°	5°	50%	80%	+30%	2°	-8°
5	8/26/12	2 PM	93°	72°	35.5%	5-SW	86°	75°	81°	14°	11°	5°	36%	80%	+44%	3°	-13°

Table II

No Test	Date and Hour		Atmospheric Conditions 1 Dry Bulb t	2 Wet Bulb t_1	3 Relative Humidity	4 Wind Miles pr. hr. & direction	Cooling-Tower 5 Initial Temp. T	6 Final Temp. T_1	7 Average Final Temp. T_a (note)	Cooling Ranges 8 Perfect Range $T-t_1$	9 Actual Range $T-T_1$	10 Average Range $T-T_a$	Efficiencies 11 Average Efficiency $\frac{T-T_a}{T-t_1}$	12 Actual Efficiency $\frac{T-T_1}{T-t_1}$	13 Above or below average ±	Relation of final Temp to wet and dry bulbs 14 Above W. Bulb	15 Above or below D. Bulb ±
1	7/8/12	3 PM	92°	77°	50%	4-SW	108°	81°	88.5°	31°	27°	19.5°	62.9%	87.1%	+24.2%	4°	-11°
2	7/10/12	"	90°	79°	61%	5-S	114°	83°	90.5°	35°	31°	23.5°	67.1%	88.6%	+21.5%	4°	-7°
3	7/21/12		71°	69°	90%	0	106°	75°	79.0°	37°	31°	27.0°	73.0%	83.8%	+10.8%	6°	+4°
4	9/2/12	2 PM	69°	65°	81%		112°	76°	78.0°	47°	36°	34.0°	72.3%	76.6%	+4.3%	11°	+7°
5	9/7/12	"	76°	70°	74%	Light	120°	78°	84.0°	50°	42°	36.0°	72.0%	84.0%	+12.0%	8°	+2°
6	9/9/12	"	86°	65°	31%	Good	125°	76°	85.0°	60°	49°	40.0°	66.0%	81.6%	+15.6%	11°	-10°
7	9/10/12	"	79°	68°	57%	Fair	124°	78°	85.0°	56°	46°	39.0°	70.0%	82.1%	+12.1%	10°	-1°

Table III

No. Test	ATMOSPHERIC CONDITIONS						COOLING-TOWER			COOLING RANGES			EFFICIENCIES			Relation of final Temp. to wet and dry bulbs	
	DATE AND HOUR		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			DRY BULB t	WET BULB t_1	Relative Humidity	WIND miles pr. hr. & direction	Initial Temp. T	Final Temp. T_1	Average Final Temp. T_a (note)	Perfect Range $T-t_1$	Actual Range $T-T_1$	Average Range $T-T_a$	Average Efficiency $\frac{T-T_a}{T-t_1}$	Actual Efficiency $\frac{T-T_1}{T-t_1}$	Above or below average ±	Above W. Bulb	Above or below D. Bulb ±
1	9/6/07	8 AM	71°	61.5°	58%		86°	75°	70°	24.5°	11°	16°	65%	45%	-20%	13.5°	+4°
2	"	8 PM	72°	63.5°	63%		87°	77°	71.5°	23.5°	10°	15.5°	66%	43%	-23%	13.5°	+5°
3	9/7/07	8 AM	68°	60.0°	62%		85°	76°	68.2°	25.0°	9°	16.8°	67%	36%	-31%	16.0°	+8°
4	"	8 PM	73°	63.5°	59%		88°	74°	72.0°	24.5°	12°	16°	65%	49%	-16%	10.5°	+1°
5	6/24/12	11.30 AM	85°	72°	53%		84°	74°	78.3°	12°	10°	5.7°	47.5%	83.3%	+35.8%	2°	-11°
6	"	1 PM	88°	70°	40%		86°	73°	78.5°	16°	13°	7.5°	46.9%	81.2%	+34.3%	3°	-15°
7	"	2 PM	88°	70°	40%		86°	73°	78.5°	16°	13°	7.5°	46.9%	81.2%	+34.3%	3°	-15°
8	"	3 PM	88°	70°	40%		86°	74°	78.5°	16°	13°	7.5°	46.9%	75.0%	+28.1%	4°	-14°



2 P.M. DAILY READINGS
MITCHELL-TAPPEN CO. ATMOSPHERIC COOLING TOWERS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 - AUGUST-1912
80°
70°
60°
ENTERING WATER
ATMOSPHERE
LEAVING WATER
WET BULB
LOW TEMPERATURE TOWER
110°
100°
90°
80°
70°
60°
ENTERING WATER
ATMOSPHERE
LEAVING WATER
WET BULB
HIGH TEMPERATURE TOWER

WATER LOSSES.

The total loss of water in fan and atmospheric towers is due to two causes, evaporation and the presence of entrained water in the air leaving the tower, due to windage. A series of three hour tests was made on a Mitchell-Tappen Atmospheric Tower to determine the total loss, in percentage of the quantity circulated.

The wind velocities are those reported by the U. S. Signal Station for the corresponding hours.

TABLE IV.

Loss of water from windage and evaporation in per cent. of circulation.										
September 1912	19th	20th	21st	22d	23d	24th	25th	26th	27th	28th
Loss of Water	2.6	2.0	2.6	2.0	2.0	3.0	1.6	2.0	2.0	2.3
Wind Velocity Miles pr. Hour	18	16	12	10	13	18	19	5	18	15
Average Loss 2.2 per cent.										

REFRIGERATING SERVICE

Swift & Co.

152nd St. and Brook Ave., New York.

GAS-ENGINE SERVICE—1100 H.P.

A striking example of our Engineering Department turning local conditions to the advantage of the owner by combining Cooling-Tower with Sprinkler-Tower.

WHEELING MOLD & FOUNDRY CO.
Wheeling, W. Va.

REFRIGERATING SERVICE

Sheffield Farms-Slawson-Decker Co.

524 West 57th Street,

New York.

OLD PAN TOWER REMODELED TO MITCHELL-TAPPEN TYPE

for

Jefferson Ice Company

Philadelphia

REFRIGERATING SERVICE

(Ammonia Condenser Carried on Same Trusses)

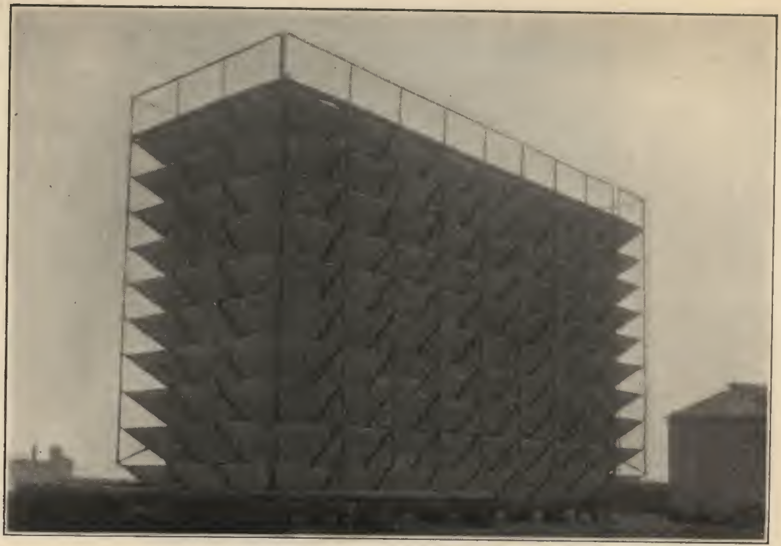
For Packing House at 10th Ave. & 13th St., New York

(Third Installation for Swift & Company)

GAS-ENGINE SERVICE—600 H. P.

American Cotton Oil Co., Guttenberg, N. J.

We installed entire cooling system, including pumps, piping, tanks, motors and regulating devices.



REFRIGERATING SERVICE

Merchants' Refrigerating Co., 22-28 Beach Street, New York.
Largest Atmospheric Tower in New York City.

MITCHELL-TAPPEN COOLING TOWERS
for
STEAM CONDENSING.

The tower illustrated on pages 38 and 39 is one of our high duty type, cooling the circulation from barometric condensers at a large central power station, and replacing one home made atmospheric and two forced-draught towers. The engines are of the Corliss pattern and the vacuum to be maintained under normal July conditions was to be 26 inches. The condensers are of the throat type in which the velocity and quantity of the circulation is relied upon to carry off the air entrained in the cooling water.

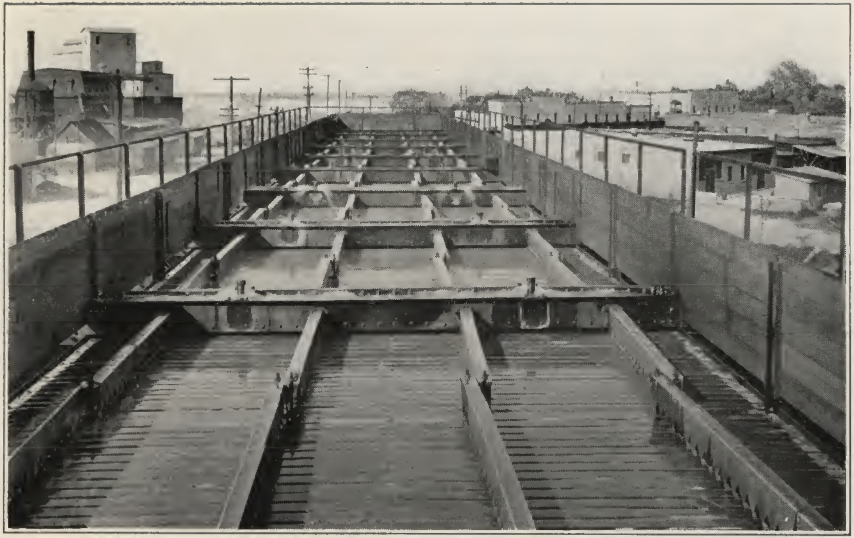
The mean July atmospheric conditions of the region are dry bulb 75 deg. F.; wet bulb 67.5 deg. F., and relative humidity 68%.

Results from tests by the owners under extreme atmospheric conditions are:

Dry bulb	98°
Wet bulb	80°
Relative Humidity	46%
Water on tower	102°
Water off tower	86°
Circulation (gals. per min.)	1,500
Horse power	1,500
Vacuum (std. bar. of 30 in.)	26″

These results are 4 deg. better than given by our standard formula on page 16 of Bulletin No. 7.

STEAM CONDENSING SERVICE
Capacity 2,000 Gallons per minute
South West Mo. R. R. Co., Webb City, Mo



DISTRIBUTING SYSTEM OF TOWER ON OPPOSITE PAGE

With high duty condensers of the jet, barometric or surface type, fitted with air pump auxiliaries, and suitable for turbine installations, 27 inches vacuum could be maintained with the above temperatures of cooling water.

The advantages of atmospheric towers, scientifically designed, and constructed of high grade materials, over forced-draught towers, in immunity from breakdowns, lessened upkeep and smaller operating charges, are very great. Compared with chimney towers, there is a saving in upkeep and a greater cooling range. The ground space occupied is considerably larger than required by other types, but the weight per square foot is so small that often useless roof space can be utilized with great advantage. If the conditions are permissible we can demonstrate the great superiority of the atmospheric type as exemplified in our design illustrated and described in Bulletin 7.

MITCHELL-TAPPEN COMPANY

Atmospheric Cooling Towers are Protected

by U. S. Patents

No. 1010020 No. 1027184

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